

06-08-00

A

UTILITY PATENT APPLICATION TRANSMITTAL

(Large Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.
13665

Total Pages in this Submission

TO THE ASSISTANT COMMISSIONER FOR PATENTSBox Patent Application
Washington, D.C. 20231

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled:

HANDOVER BETWEEN MOBILE COMMUNICATION NETWORKS

and invented by:

David Cooper

If a CONTINUATION APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: _____

Which is a:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: _____

Which is a:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: _____

Enclosed are:

Application Elements

1. ☒ Filing fee as calculated and transmitted as described below
2. ☒ Specification having 26 pages and including the following:
 - a. ☒ Descriptive Title of the Invention
 - b. ☐ Cross References to Related Applications (if applicable)
 - c. ☐ Statement Regarding Federally-sponsored Research/Development (if applicable)
 - d. ☐ Reference to Microfiche Appendix (if applicable)
 - e. ☒ Background of the Invention
 - f. ☒ Brief Summary of the Invention
 - g. ☒ Brief Description of the Drawings (if drawings filed)
 - h. ☒ Detailed Description
 - i. ☒ Claim(s) as Classified Below
 - j. ☒ Abstract of the Disclosure

UTILITY PATENT APPLICATION TRANSMITTAL

(Large Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.

13665

Total Pages in this Submission

Application Elements (Continued)

3. ☒ Drawing(s) (when necessary as prescribed by 35 USC 113)
- a. ☒ Formal Number of Sheets 1
- b. ☐ Informal Number of Sheets _____
4. ☐ Oath or Declaration
- a. ☐ Newly executed (original or copy) ☐ Unexecuted
- b. ☐ Copy from a prior application (37 CFR 1.63(d)) (for continuation/divisional application only)
- c. ☐ With Power of Attorney ☐ Without Power of Attorney
- d. ☐ DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application,
see 37 C.F.R. 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation By Reference (usable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied
under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby
incorporated by reference therein.
6. ☐ Computer Program in Microfiche (Appendix)
7. ☐ Nucleotide and/or Amino Acid Sequence Submission (if applicable, all must be included)
- a. ☐ Paper Copy
- b. ☐ Computer Readable Copy (identical to computer copy)
- c. ☐ Statement Verifying Identical Paper and Computer Readable Copy

Accompanying Application Parts

8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(B) Statement (when there is an assignee)
10. ☐ English Translation Document (if applicable)
11. ☐ Information Disclosure Statement/PTO-1449 ☐ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Acknowledgment postcard
14. ☒ Certificate of Mailing
- ☐ First Class ☐ Express Mail (Specify Label No.): EL308568555US

UTILITY PATENT APPLICATION TRANSMITTAL
(Large Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.
13665

Total Pages in this Submission

Accompanying Application Parts (Continued)

15. ☐ Certified Copy of Priority Document(s) *(if foreign priority is claimed)*

16. ☒ Additional Enclosures *(please identify below):*

Claim of Priority in Due Course

Fee Calculation and Transmittal

CLAIMS AS FILED

For	#Filed	#Allowed	#Extra	Rate	Fee
Total Claims	27	- 20 =	7	x \$18.00	\$126.00
Indep. Claims	15	- 3 =	12	x \$78.00	\$936.00
Multiple Dependent Claims (check if applicable) <input type="checkbox"/>					\$0.00
BASIC FEE					\$690.00
OTHER FEE <i>(specify purpose)</i>					\$0.00
TOTAL FILING FEE					\$1,752.00

- ☒ A check in the amount of \$1,752.00 to cover the filing fee is enclosed.
- ☒ The Commissioner is hereby authorized to charge and credit Deposit Account No. 19-1013/SSMP as described below. A duplicate copy of this sheet is enclosed.
- ☐ Charge the amount of _____ as filing fee.
- ☒ Credit any overpayment.
- ☒ Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
- ☐ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).

Signature

Paul J. Esatto, Jr.
Registration No. 30, 749

Scully, Scott, Murphy & Presser
400 Garden City Plaza
Garden City, NY 11530
(516) 742- 4343

Dated: June 7, 2000

CC:

CERTIFICATE OF MAILING BY "EXPRESS MAIL" (37 CFR 1.10)Applicant(s): **David Cooper**

Docket No.

13665

Serial No.

To be assigned

Filing Date

Herewith

Examiner

Unassigned

Group Art Unit

Unassigned

Invention: **HANDOVER BETWEEN MOBILE COMMUNICATION NETWORKS**jc-035 U.S. PRO
09/589217
06/07/00I hereby certify that this New Patent Application

(Identify type of correspondence)

is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under
37 CFR 1.10 in an envelope addressed to: The Assistant Commissioner for Patents, Washington, D.C. 20231

on June 7, 2000
(Date)

Mishelle Spina

(Typed or Printed Name of Person Mailing Correspondence)


(Signature of Person Mailing Correspondence)EL308568555US

("Express Mail" Mailing Label Number)

Note: Each paper must have its own certificate of mailing.

HANDOVER BETWEEN MOBILE COMMUNICATION NETWORKS

BACKGROUND OF THE INVENTION

1. Field of the Invention:

5 The present invention is concerned with handover
of a call between mobile communication networks. The
present invention is particularly concerned with
handover between UMTS networks and GSM networks but is
also applicable to handover between different GSM
10 networks and different cellular mobile communication
networks generally.

2. Description of the Related Art:

In current GSM systems, it is possible for a user
to select manually among a plurality of available GSM
15 networks when a mobile device (User Equipment) is off
line. It is also possible for the User Equipment to
select a network automatically from among the available
networks based on preferences stored in the User
Equipment, normally in the SIM card. However, when a
20 call is in progress, this selection is not possible. In
the present specification, the term User Equipment is
intended to encompass any equipment capable of
communicating with a network; this will typically be a
mobile telephone, but may be, for example, a dedicated
25 data, facsimile, E-mail or video communication device
or combination device.

During call progress, the majority of the User Equipment's radio resource are involved in the active call and so it is not possible to scan broadly for available networks. To enable a mobile device to move
5 between cells, while a call is in progress, the network supplies a limited list of adjacent cells, normally confined to cells provided by the same network provider and permits the mobile device to make limited investigation of signal strength from the neighboring
10 cells. In the event that the mobile device finds a stronger signal from another cell, it can signal a change to the other cell.

According to above prior method, it is not impossible to hand over between mobile communication networks
15 while call is in progress.

It has been appreciated that it would be desirable to enable User Equipment to select a preferred one of a plurality of available networks while a call is in progress. This would be particularly beneficial when
20 handing over from a UMTS network to a selected GSM network', but would also be useful, particularly when traveling outside the User Equipment's home network territory, to enable handover between preferred "foreign" networks.

25 It has been appreciated that, although this is not normally done, it would be possible for an active

002090 270000

network to supply a list of cells not only belonging to the active network, but also including cells of other network providers. This potentially offers a solution to the problem mentioned above, and may be provided independently in an aspect of the invention.

However, to implement the system, the network provider would have to supply a significant amount of information concerning other network providers' cells. Therefore, the above mentioned potential solution has the attendant problem that the list of available cells may become too large in practical terms for the User Equipment to investigate during an active call, and this may degrade performance of the network. This solution may therefore be undesirable for many network providers.

SUMMARY OF THE INVENTION

It is an object of the present invention is to provide a method capable of handing over between mobile communication networks while call is in progress.

Pursuant to the invention, an improved solution has been proposed. According to the first main aspect of the invention, the invention provides a method of facilitating handover from an active network with which User Equipment is in communication to another network. According to the present invention, the active network

provides a list of available other networks to the User Equipment. User Equipment selects among the available networks based on preference information and signals to the active network at least one preferred other network.

- 5 The active network provides neighbor cell information for the at least one preferred other network to the User Equipment.

In this way, the User Equipment may signal a preferred network to the active network and then the
10 active network may transmit cell information for only the preferred network(s) to that User Equipment.

The preference information may be stored in the User Equipment, preferably in the SIM card. The preference information may include a list of networks
15 which are "black listed" with which the User Equipment is not able to connect. The preference information may also include a list of networks which are "white listed" with which communication is preferred. The white list may include partner networks of the home
20 network provider. The preference information may include an explicit "gray list" of networks which are to be tried in the absence of a "white listed" network; alternatively, networks which are not explicitly in the white list or black list may be deemed to be in the
25 gray list. Multiple levels of preference may be stored. Preferably, the method includes storing in the User

Equipment a list of available networks based on
information supplied by the active network. This
feature, using information supplied by a network rather
than that obtained by a (relatively lengthy) search
5 performed by the User Equipment, offers advantages.

The method may include incrementally adding to or
deleting from the list of available networks stored in
the User Equipment. This feature avoids the need to re-
transmit a complete list, thereby allowing shorter
10 messages to be used.

Using the method of claim 1, it becomes possible
for a network to send different neighbor cell
information to different terminals (User Equipment),
based on preferences expressed by the terminals and not
15 solely dependent on the area in which the terminals are
located.

The signalling of available networks by an active
network, the first step in the method of claim 1, is of
itself a useful step as it provides a terminal with
20 information concerning available networks without the
terminal having to search.

The signalling by a terminal to an active network
with which the terminal is in communication of a
preferred (other) network (effectively the second step
25 in the method of claim 1) in itself provides useful
information to the active network.

The invention extends to methods of operating terminals and to methods of operating networks, terminals and network for implementing any the above aspects.

5 In a first preferred implementation, the active network is a UMTS network and the list of available networks comprises a list of available GSM networks. This implementation facilitates handover from UMTS to a selected GSM network.

10 In a second implementation, the active network is a GSM network (or a UMTS network) provided by an active network provider and the list of available networks comprises a list of other GSM networks (or UMTS networks) provided by other network providers. This
15 facilitates handover within a communication system between network providers.

The above and other objects, features and advantages of the present invention will become apparent from the following description with reference
20 to the accompanying drawings which illustrate examples of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a flowchart showing a processing of the
25 first embodiment according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the invention will now be described, by way of example.

5 By way of explanation, we will describe in general terms, the elements of a practical implementation of a handover system embodying several of the above aspects and advantageous features. The following applies to both handover between networks of a similar type (e.g. 10 GSM) belonging to different network providers, or between networks - of differing types (e.g. UMTS to GSM), unless otherwise stated. Indeed, in certain applications it may be possible to select between multiple networks of multiple types, for example GSM 15 900, GSM 1900, UMTS and local coverage networks.

Features of User Equipment

In addition to "standard" user equipment features, for communicating with the networks between which 20 handover is to be performed (for a UMTS to GSM handover, this requires a dual mode terminal), the user equipment should ideally have the following components:-

A store for a list of network preferences.

This may be based on an existing store, preferably 25 in the SIM card (which term as used in this specification is intended to encompass any removable

device which is used to configure a standard handset),
and will normally be at least partially pre-programmed
by the home network provider. The equipment may be
configured to allow the user to edit at least part of
5 this list, for example by adding networks or modifying
preference levels.

In particular, where a network provider has two or more
partner networks in a given (foreign) country and the
charges vary (either permanently or from time to time)
10 between networks, the user (or the network provider)
may update the preference list so that the cheaper
network is always preferred. The preference list may
simply be binary, 0 for never use ("blacklisted"), 1
for use if possible ("white listed"), unlisted networks
15 being used if a network annotated 1 is not found.

Alternatively, multiple levels may be stored; this
facilitates differentiation on the basis of pricing. If
multiple levels are used, the home network may be given
a unique, highest, preference. If only two or a few
20 levels are provided, the home network may nonetheless
be specifically marked, if desired. Although it is
greatly preferred to store the preferences, the user
may be prompted to select all alternative network on
demand; this will normally be inconvenient during a
25 voice call, but may be more acceptable in a data
communication application. The order in which the

networks are listed may or may not be significant; if it is, even in a binary system, the order of networks within the stored list may be used to designate preference and all white listed networks may be ranked in order. Thus, in the selecting step, the User Equipment may be arranged to find the first white listed available network.

- Means for receiving and interpreting a message specifying available networks.

The User Equipment must be able to interpret a special message sent during an active call from the active network listing possible handover networks. This may be based on existing facilities for interpreting messages during a call, the special message being identified by a special prefix or identifier agreed with the network. It is to be noted that it may only be possible to perform preferential handover from certain networks but not others, particularly where certain networks are not configured to provide special messages identifying neighboring networks. For example, in the case of UMTS to GSM handover, the UMTS network may be arranged to provide a list of candidate GSM networks, but, when attempting to hand back to UMTS from a GSM network, or when attempting to hand over between at

least certain GSM networks, this may not be possible as the GSM network(s) may not be adapted to provide lists of candidate networks.

- 5 -Means for maintaining list of available networks.

Preferably, the User Equipment is able, in addition to (or instead of) receiving a complete list of available networks, to receive and interpret messages specifying incremental addition or deletion of
10 networks from the current list of available networks. In this way, a complete list of available networks may be built up in the User Equipment by a series of "ADD" messages, rather than by transmitting a complete list. This feature is particularly desirable in regions where
15 there are a number of networks from which to choose and the availability of each network changes from place to place frequently, as it avoids the need to re-transmit a long list each time one network becomes or ceases to be available.

20

- Means for requesting a list of available networks.

The network may be arranged to transmit available
25 network information regularly or when the network determines that handover is desirable (for example when

the received signal becomes weak). However, preferably, the User Equipment is able specifically to request this information; this may be achieved in a similar manner to the conventional manner for User Equipment to send a
5 handover, but using a message identifier agreed with the network as signifying a request for available networks.

- Means for comparing the list of available
10 networks to the list of preferences and selecting a network.

This may be achieved simply by searching for each available network in the list of preferences and
15 returning the one (or top several) with the highest preference. Where more than one available network has an equal top preference, the User Equipment may select several in turn and then, following receipt of radio cell information, select the network with the strongest
20 signal. Alternatively, other criteria may be provided.

- Means for signalling the preferred network.

This may be achieved simply by sending a message
25 with an identifier agreed with the network to signify a network selection.

002099-400500

Thereafter, the network would supply neighbor cell information for the selected network(s) in a similar manner to that presently used to enable cell-to-cell handover and the User Equipment would treat this cell

5 information (radio frequencies, time slots codes, etc.) in the same way to find the most suitable handover candidate.

Features of Network

- 10 In addition to "standard" network parameters, a network should implement the following features:-
- Store of list of available other networks.

This list varies from point to point, so it is

15 conveniently stored at each base station or radio access point. This may be based on stored information, obtained either based on knowledge of other networks in the area and predicted coverage, or based on empirical data, for example obtained by scanning for radio

20 coverage throughout the region covered by a cell, or by fixed receivers located at the access point and surrounding access points. Normally the network will not know the position of the User Equipment to much better than 1 cell accuracy (although, by triangulation

25 from other cells in the network, accurate positioning is possible; alternatively, a rough idea of direction

network to the active network. At step 104, the active network looks up cell information for preferred network and signals neighbor cell information to the User Equipment. At step 105, the User Equipment searches for
5 cell availability, determines cell and network and signals handover to specific cell. Finally, at step 106, handover to new network is implemented.

2nd embodiment;

10 The first embodiment above deals with transmission of a complete list of available networks in response to a specific request. The following second embodiment deals in particular with incremental updating of the list of available networks, and these details may be
15 used in other contexts (not only in the UMTS to GSM handover case in which it is explained), for example in GSM to GSM handover.

Application to UMTS to GSM handover

20 Three novel signaling procedures are proposed as below. All these procedures rely on local interaction between the dual mode terminal and the UTRAN, with no involvement of the VLR or core network.

We will assume that while a dual mode terminal has
25 a call in progress, it maintains a list of potential GSM handover candidates { G1, G2, G3,...} (which may

contain no entries if no potential GSM handover
candidate is available). At any time it also has a
preferred candidate Gpref which is a member of { G1, G2,
G3,...}. This proposal describes signalling means
5 whereby this list is maintained.

Signalling the availability of candidate GSM networks

At any time during a call the serving UMTS network
U can signal to the dual mode terminal the identity of
10 one or more GSM network that are available, {Gi.} for
potential handover. This signal contains the unique
network identifier of each potential GSM network. This
message would typically be used when the terminal first
enters the coverage area of a potential candidate GSM
15 network while a call is active, or sets up a call while
within its coverage area,

The terminal records the identity of the GSM
networks, and compare it with internally stored
information (for example a network preference list
20 stored on the SIM and the identity of other available
GSM networks previously signalled to it) and signals
its preference Gpref back to the serving network, if it
can identify a suitable network.

After this the serving network provides neighbor
25 cell information relating to network Gpref until such
time as the call ends, the terminal leaves the network

or the terminal indicates a new value of Gpref.

Signalling the non-availability of an existing candidate GSM network

5 When the terminal leaves the coverage area of a
potential candidate GSM network during a call, the
serving radio network U can signal to the terminal at
any time the identity of GSM networks, {Gi.} that are
now unavailable. This signal contains the unique
10 network identifier of the GSM network which is no
longer available.

The terminal can note that this GSM network is no
longer available, and using internally stored
information (for example a network preference list
15 stored on the SIM and the identity of remaining
available GSM networks) signals its preference Gpref
back to the serving network, if a suitable network is
identified.

After this the serving network provides neighbor
20 cell information relating to network Gpref until such
time as the call ends, the terminal leaves the network
or the terminal indicates a new value of Gpref.

Terminal network preference

25 At any time the terminal can signal a new
preference Gpref back to the serving network, which

would be chosen from the list of available networks.
After this the serving network provides neighbor cell
information relating to network Gpref until such time
as the call ends, the terminal leaves the network or
5 the terminal indicates a new value of Gpref.

Typically this signal would be sent if the list of
available GSM network changed in such a way that the
preferred network needed to be re-evaluated.

In the above described second embodiment, the
10 mobile device always has a preferred other network
stored and is therefore regularly updated with neighbor
cell information for that preferred network. This is
particularly useful in the case of a dual mode terminal
(the case of UMTS, to GSM handover being one example,
15 GSM 900 to GSM 1900 being another example) where the
"unused" mode components can be kept up dated and ready
to change as soon as required.

To summarize, the above embodiments provide the
following novel features, each of which may be
20 independently provided:-

- The signalling of available GSM candidate network
information.
- The maintenance in the terminal of a list of
available networks.
- 25 - The possibility of incremental addition and deletion
of elements of that list.

- The ability of the terminal to indicate the preferred network.

- The ability to send selective neighbor cell information to different dual mode terminals, so that
5 different terminals within the same area may receive different neighbor cell information.

While preferred embodiments of the present invention have been described using specific terms, such description is for illustrative purposes only, and
10 it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

What is claimed is:

1. A method of facilitating handover from an active network with which User Equipment is in communication to another network, the method comprising the steps of:

- providing a list of available other networks to
5 said User Equipment via the active network;
in the User Equipment, selecting among the
available networks based on preference information and
signalling to said active network at least one preferred
other network; and
10 providing neighbor cell information for the at
least one preferred other network to said User Equipment
via the active network.

2. A method of facilitating handover from an active network with which User Equipment is in communication to another network, the method comprising a step of
providing to User Equipment communicating via the active
5 network a list of available other networks.

3. A method of facilitating handover from an active network with which User Equipment is in communication to another network, the method comprising the steps of:
receiving from User Equipment communicating via the
5 active network an indication of at least one preferred
other network; and

in response thereto, providing neighbor cell
information for the at least one preferred other network.

4. A method of operating User Equipment capable of
handover between an active network and another network
comprising a step of storing in the User Equipment a list
of available networks based on information supplied by
5 the active network with which the User Equipment is in
communication.

5. A method according to claim 4 further comprising a
step of incrementally adding to or subtracting from the
list of available networks.

6. A method according to claim 2 further comprising a
step of sending a message to the User Equipment
containing information for incrementally adding to or
subtracting from the list of available networks.

7. A method of operating an active network to
facilitate handover to another network comprising a step
of providing to User Equipment communicating via the
active network a message containing information for
5 incrementally adding to or subtracting from a stored list
of available networks.

8. A method of operating User Equipment capable of handover between an active network and another network comprising a step of incrementally adding to or subtracting from a stored list of available networks
5 based on information supplied by the active network with which the User Equipment is in communication.

9. A method of operating User Equipment capable of handover between an active network and another network comprising a step of signalling to the active network with which the User Equipment is in communication a
5 preferred other network for handover.

10. A method according to claim 9, wherein said preferred other network is selected by the User Equipment from a list of available networks supplied by the network.

11. A method of operating an active network with which User Equipment is in communication comprising a step of sending neighbor cell information to User Equipment based on network preferences communicated by the User Equipment.

12. A method according to claim 11 comprising a step of sending mutually different neighbor cell information to mutually different User Equipments based on mutually

different network preferences.

13. A method according to claim 1, wherein the preferred other network is selected based on information stored in the User Equipment, preferably in a SIM card.

14. A method according to claim 1, wherein the active network is a UMTS network and the other network is selected from available GSM networks.

15. A method according to claim 1, wherein the active network is provided by an active network provider and the other network is selected from networks provided by other network providers.

16. User Equipment for a mobile communications system capable of handover from an active network with which User Equipment is in communication to another network comprising means for storing a list of available
5 other networks supplied by the active network.

17. User Equipment according to claim 16, further comprising means for updating the stored list of available other networks based on information supplied by the active network.

18. User Equipment for a mobile communications system capable of handover from an active network with which User Equipment is in communication to another network comprising means for updating a stored list of
5 available other networks based on information supplied by the active network.

19. User Equipment for a mobile communications system capable of handover from an active network with which User Equipment is in communication to another network comprising means for signalling a preferred other
5 network to the active network during a call.

20. User Equipment according to claim 19, further comprising means for storing network preference information.

21. User Equipment according to claim 16, wherein the active network is a UMTS network and the other network is a GSM network, having means for communicating over both networks.

22. A mobile communications network or component thereof including means for communicating to User Equipment communicating with the network a list of available other networks.

002090 2700500

23. A mobile communications network or component thereof according to claim 22 having means for sending a message to me User Equipment containing information for incrementally adding to or subtracting from the list of available networks.

5

24. A mobile communications network or component thereof including means for sending a message to User Equipment containing information for incrementally adding to or subtracting from a list of available networks stored in the User Equipment.

5

25. A mobile communications network or component thereof including means for receiving from User Equipment communicating with the network an indication of a preferred other network and means for supplying neighboring cell information for the preferred other network.

5

26. A mobile communications network or component thereof including means for sending neighbor cell information to User Equipment based on network preferences communicated by the User Equipment.

27. A mobile communications network or component

thereof according to claim 26 arranged to send mutually
different neighbor cell information to mutually different

- 5 User Equipments based on mutually different network
preferences.

ABSTRACT OF THE DISCLOSURE

The invention provides a method of handover from an active network to a selected one of a plurality of potential other networks. In addition to the overall

5 solution, the solution proposed has several individual aspects. All subsidiary aspects are related to the common problem mentioned above and sharing the underlying common solution concept of implementing a system in which selective handover is possible and in which a list of
10 available other networks provided by an active network can be handled and selection made by a terminal, so that neighbor cell information can be transmitted based on expressed terminal preferences.

Fig. 1

